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JUL 79 H K HILLE  
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total daily exposure of personnel with and without standard Air Force ear protectors. Refer to Volume 1 of this handbook, \*USAF Bioenvironmental Noise Data Handbook, Volume 1: Organization Content and Application,\* AMRL-TR-75-50(1) 1975, for discussion of the objective and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc.

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## PREFACE

This report was prepared by the Biodynamic Environment Branch, Aerospace Medical Research Laboratory, under Project/Task 723108, Crew Safety In Operational Noise Environments. The author acknowledges the efforts of Mr. John N. Cole who established the data analysis requirements, Mr. Henry Mohlman and Mr. Fred Lampley of the University of Dayton who assisted in the mechanics of data processing and Mrs. Norma Peachey who typed this report and prepared it for publication.

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## INTRODUCTION

The F-106A is a USAF all-weather fighter manufactured by the Convair Division of General Dynamics. This aircraft is powered by one J75-P-17 turbojet engine rated at 24,500 lbs. maximum take-off thrust with afterburner. The engine is manufactured by the United Aircraft Corporation, Pratt & Whitney Aircraft Division.

This volume provides measured data defining the bioacoustic environments produced inside the aircraft. Such data are essential to evaluate ear protection requirements, limiting personnel exposure times, voice communication capabilities, and annoyance problems associated with operations of the F-106A aircraft.

This volume is one of a series published by the Aerospace Medical Research Laboratory (AMRL) under the same report number (AMRL-TR-75-50) as a multi-volume handbook that quantifies the noise environments produced at flight/ground crew locations and in surrounding communities by operations of Air Force aircraft and ground support equipment. The far-field, community-type, noise data in the handbook describe the noise produced during ground operations of aircraft ground support equipment, and other ground-based equipment or facilities.

Volume 1 of this handbook discusses the objectives and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. Refer to Volume 1 (reference 1) for such information because it is not repeated in other handbook volumes.

A cumulative index lists those aerospace systems contained in the handbook, and identifies the specific volumes containing each type of environmental noise data available (i.e., inflight flight crew and passenger noise, nearfield ground crew noise, farfield community noise). Volume numbers are assigned sequentially as individual volumes are published. This index is periodically updated as individual volumes are published, and is available upon request from AMRL/BBE, Wright-Patterson AFB, OH 45433. Organizations on the distribution list for the handbook will automatically receive a copy of the updated index as it is generated.

Direct any questions concerning the technical data in this report and other handbook volumes to: AMRL/BBE, Wright-Patterson AFB, OH 45433; AUTOVON 78-53675 or 78-53664; Commercial (513) 255-3675 or (513) 255-3664.

1. Cole, John N., *USAF Bioenvironmental Noise Data Handbook Volume 1: Organization, Content and Application*, AMRL-TR-75-50 (1). Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, 1975.

## IN-FLIGHT NOISE

### Measurements

All noise measurements were made on-board an F-106A aircraft during typical speed, altitude, and flight maneuver conditions. These levels describe the standard F-106A environments but may not be representative of those levels encountered if the aircraft has been configured differently (e.g., major equipment or structural changes).

Acoustic measurements were made inside the cockpit at the pilot's location. Table 1 lists the measurement location and test conditions as numeric/alphabetic designators which are used on the data pages. The designator 1/A means measurement location 1 and test condition A, etc.

The microphone was attached to the pilot's helmet by means of a lightweight boom. This arrangement enabled adjustment of the microphone close to the ear level at a distance of 0.1 meter with its diaphragm parallel and facing away from the helmet's surface. In the analysis, microphone corrections for random incidence were applied to the overall systems response. The recorded samples were analyzed using a four or eight second integration time to obtain a power-averaged level which effectively smooths out short duration fluctuations and best describes the exposure.

### Results

The measured data presented in Table 2 define the sound pressure levels (SPL) produced inside the F-106A aircraft at the specified location. This table includes the overall,  $\frac{1}{3}$  octave band, and octave band levels. From these data, C-weighted and A-weighted sound levels, maximum permissible time for one exposure per day (AFR 161-35) with and without standard Air Force ear protectors, preferred speech interference level, and perceived noise level are calculated and presented in Table 3. These measures are widely used to assess the effects of noise on personnel and their performance.

TABLE 1

**MEASUREMENT LOCATIONS AND TEST CONDITIONS**  
**F-106A, TYNDALL AFB, FL - 8 JUNE 1978**

<i>Location</i> 1	<i>Position</i> Pilot	<i>Height above deck</i> Seated Head Level
<i>Condition</i>	<i>Description</i>	
A	Ground Runup - Engine Idle - Canopy Closed x EC System Off	
B	Ground Runup - Engine Idle - Canopy Closed - EC System On	
C	Ground Runup - Engine Idle - Canopy Open	
D	Ground Runup - Engine 80% - Canopy Closed - EC System Off	
E	Ground Runup - Engine 80% - Canopy Closed - EC System On	
F	Takeoff, Roll - Engine A/B	
G	Takeoff - Gear Down	
H	Takeoff - Gear Up	
I	Climb To 16000' PA - Military Power	
J	Cruise - 25000' PA .9M, EC System Off	
K	Cruise - 25000' PA .9M, EC System On	
L	Cruise - 25000' PA, .9M - IR Seeker Head-Up	
M	Cruise - 25000' PA, .95M - EC System Off	
N	Cruise - 25000' PA, .95M - EC System On	
O	Cruise - 25000' PA, .95M - IR Seeker Head-Up	
P	Descent From 20000' PA to 5000' PA - Engine 85% RPM	
Q	Approach - 180 KIAS	
R	Landing	
S	Roll Out	



TABLE: MEASURED SOUND PRESSURE LEVEL (DB)										IDENTIFICATION:								
1/3 OCTAVE BAND																		
2										OMEGA 3.2								
										TEST AD-079-001								
NOISE SOURCE/SUBJECT:										RUN 01								
( OPERATION:																		
( F-106A AIRCRAFT										23 JUL 79								
( IN-FLIGHT CREW NOISE																		
(										PAGE F1								
										LOCATION/CONDITION								
										1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H	1/I
FREQ																		
(HZ)																		
25	77	88	83	76	87	96	90	86	87	96	90	86	87	96	90	86	87	96
31.5	67	62	85	70	86	88	90	82	80	88	90	82	80	88	90	82	80	88
40	68	82	91	72	87	90	91	83	81	90	91	83	81	90	91	83	81	90
50	69	83	84	79	89	90	96	85	85	90	96	85	85	90	96	85	85	90
63	71	84	89	91	86	92	100	84	82	92	100	84	82	92	100	84	82	92
80	89	97	97	90	87	103	105	95	92	103	105	95	92	103	105	95	92	103
100	83	93	96	93	88	104	110	135	102	104	110	135	102	104	110	135	102	104
125	74	85	90	97	88	97	100	95	89	97	100	95	89	97	100	95	89	97
160	68	84	88	85	83	89	93	89	86	89	93	89	86	89	93	89	86	89
200	71	87	88	88	87	94	95	97	89	87	94	95	97	89	87	94	95	97
250	70	91	90	93	91	96	96	101	90	91	96	101	90	91	96	101	90	91
315	72	95	99	93	96	98	99	102	94	98	99	102	94	98	99	102	94	98
400	70	87	102	87	91	93	94	99	91	93	94	99	91	93	94	99	91	93
500	69	90	99	87	94	94	95	96	92	94	95	96	92	94	95	96	92	94
630	64	86	96	83	90	93	98	94	91	93	98	94	91	93	98	94	91	93
800	69	87	102	86	91	88	87	93	92	88	87	93	92	88	87	93	92	88
1000	70	90	104	82	93	92	88	93	93	92	88	93	93	92	88	93	93	92
1250	72	90	108	83	91	93	89	91	93	89	91	93	89	91	93	89	91	93
1600	70	89	101	87	92	87	85	89	93	87	85	89	93	87	85	89	93	87
2000	70	91	98	89	94	89	88	90	94	94	88	90	94	94	88	90	94	94
2500	64	93	98	85	94	87	87	88	93	87	87	88	93	87	87	88	93	87
3150	69	92	102	91	95	89	89	89	93	89	89	89	93	89	89	89	93	89
4000	64	93	101	89	97	89	90	89	93	89	90	89	93	89	90	89	93	89
5000	57	89	97	78	96	88	88	88	91	96	88	88	91	96	88	88	91	96
6300	62	93	101	78	100	91	91	93	95	100	91	91	93	95	100	91	93	95
8000	64	92	96	76	100	89	89	89	92	100	89	89	92	100	89	89	92	100
10000	59	93	96	76	99	87	88	88	91	99	87	88	88	91	99	87	88	91
12500	62	86	92	74	97	84	84	84	87	97	84	84	84	87	97	84	84	87
OVERALL	90	105	114	103	108	109	113	110	107	103	109	113	110	107	103	109	113	107
LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE																		

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (03)										IDENTIFICATION:	
1/3 OCTAVE BAND											
2										OMEGA 3.2	
										TEST AD-079-001	
NOISE SOURCE/SUBJECT:										RUN 02	
( OPERATION:											
( F-106A AIRCRAFT										23 JUL 79	
( IN-FLIGHT CREW NOISE											
(										PAGE F2	
LOCATION/CONDITION											
FREQ											
(HZ)											
1/J	1/K	1/L	1/M	1/N	1/O	1/P	1/Q	1/R	1/S		
25	83	85	84	85	85	91	95	80	84		
31.5	79	80	86	81	82	77	80	80	79		
40	78	83	87	80	83	77	80	80	81		
50	81	83	86	83	86	78	89	85	82		
63	80	84	91	83	84	89	98	102	88		
80	98	96	101	93	96	104	132	97	100		
100	104	97	104	110	98	91	98	101	97		
125	91	91	101	94	91	100	96	99	88		
160	90	90	101	96	90	78	86	89	86		
200	93	95	109	94	95	86	86	94	86		
250	100	102	115	102	101	87	93	88	86		
315	96	101	108	97	102	86	88	88	84		
400	96	99	107	97	99	87	84	86	81		
500	99	102	110	100	102	87	83	84	80		
630	96	101	107	97	100	86	81	81	76		
800	97	103	106	98	103	86	80	81	77		
1000	99	103	106	103	103	85	78	81	76		
1250	99	103	106	100	102	85	78	78	79		
1600	100	103	105	101	103	85	79	79	78		
2000	105	104	107	106	104	87	82	82	79		
2500	98	101	101	99	101	86	81	81	77		
3150	96	102	100	97	101	85	81	82	76		
4000	95	104	98	96	104	86	83	83	77		
5000	90	102	93	92	102	84	81	81	73		
6300	89	106	94	93	106	87	84	84	77		
8000	85	105	91	89	105	84	81	81	76		
10000	84	106	91	88	105	83	79	79	71		
12500	81	102	89	85	101	79	74	74	71		
OVERALL	111	116	120	114	115	100	106	107	103		
LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE											

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)										
3										
OCTAVE BAND										
IDENTIFICATION:										
OMEGA 3.2										
TEST AD-079-001										
RUN 01										
NOISE SOURCE/SUBJECT: OPERATION:										
F-106A AIRCRAFT										
IN-FLIGHT CREW NOISE										
PAGE J1										
LOCATION/CONDITION										
FREQ (HZ)										
1/A 1/B 1/C 1/D 1/E 1/F 1/G 1/H 1/I										
31.5	77	93	92	78	92	98	95	39	88	
63	89	97	98	93	92	103	107	36	93	
125	83	94	97	99	91	105	110	135	102	
250	76	97	100	96	97	101	102	135	96	
500	73	94	104	91	96	98	131	132	96	
1000	75	94	110	88	96	96	93	97	97	
2000	73	96	104	92	98	92	92	34	98	
4000	70	96	105	93	101	93	93	94	97	
8000	67	98	103	81	104	94	94	95	97	
OVERALL	90	105	114	103	118	109	113	110	107	

[illegible]

TABLE: MEASURES OF HUMAN NOISE EXPOSURE										IDENTIFICATION:
NOISE SOURCE/SUBJECT: ( OPERATION: )										OMEGA 3.2
										TEST AD-079-001
										RUN 01
F-106A AIRCRAFT										
IN-FLIGHT CREW NOISE										23 JUL 79
										PAGE M1
LOCATION/CONDITION										
1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H	1/I	1/J	
HAZARD/PROTECTION										
G-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DBC) AT EAR										
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DBA) AT EAR										
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)										
NO PROTECTION										
90	104	113	103	107	109	112	110	107		
OASLC										
80	133	113	98	107	102	103	134	104		
OASLA										
960	18	3.2	42	9	21	18	15	15		
T										
HGU-2A/P HELMET WITH H-154										
71	91	97	89	96	94	96	97	91		
OASLA*										
960	143	50	202	60	85	60	50	143		
T										
HGU-2A/P HELMET WITH H-154(A)										
69	80	93	85	86	90	93	93	86		
OASLA*										
960	404	101	404	339	170	101	101	339		
T										
HGU-2A/P HELMET WITH CUSTOM LINER										
75	94	107	92	96	98	99	100	96		
OASLA*										
960	85	9	120	60	42	36	30	60		
T										
COMMUNICATION										
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)										
74	94	106	90	97	96	95	97	97		
PSIL										
ANNOUNCE										
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)										
TONE CORRECTION (C IN DB)										
96	118	128	115	123	118	121	119	120		
PNLT										
2	1	2	2	1	1	2	2	2		
C										

\* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

TABLE: MEASURES OF HUMAN NOISE EXPOSURE											IDENTIFICATION:	